Stormwater supply: All the water used in the experiments is stormwater runoff. NRMRL collects the runoff from a 58-cm (23-in) diameter, on-site stormwater discharge. A 30-cm (12-in) pipe routes the runoff from the storm sewer to 76 m^3 (20,000 gal) collection tanks where it is stored until needed.

A centrifugal pump transfers the mixed water from the storage tank to the top of the swale. The transfer is controlled to enable the experiment to establish the wanted flowing water depth within the swale.

All water exiting the swale is captured. All water collection tanks have a PVC liner to prevent contamination. NRMRL developed techniques to stir the entire volume in each tank and collect a sample representative of the contents.

Benefits: A more complete understanding of how swales operate will enable EPA to provide national guidelines on the design, construction, maintenance and monitoring that local organizations can use to reduce the pollutants reaching receiving waters. Reducing the pollutants in runoff will better enable our waters to fulfill their designated uses. Swales and other Best Management Practices will help watershed managers assure that receiving waters meet the "fishable and swimable" goals that Congress outlined in the Clean Water Act and better assure the continuing supply of high-quality, potable water needed for human life.

About Us

The NRMRL swale evaluation is part of a larger collection of long-term research projects that evaluates many Best Management Practices. EPA has ongoing research examining the performance of constructed wetlands, and detention and retention ponds. Other projects will evaluate rain gardens and porous pavement.

The three swales with the collection tanks occupy nearly 1-acre of land. NRMRL operates the 20-acre Urban Watershed Research Facility that includes stormwater mesocosms, laboratories, greenhouses, fabrication space, pipeline testing facility and storage for equipment and supplies. This unique facility is part of a larger 210-acre EPA facility operated by Region 2 in Edison, NJ. This land area allows NRMRL to undertake research on a scale that cannot be executed at any other EPA facility.

For more information Contact Michael Borst (732) 321-6631 or borst.mike@epa.gov. For more information about controlling and treating wet weather flow and water infrastructure integrity, go to the Urban Watershed Management Branch website: http://www.epa.gov/ednnrmrl/.

EPA United States Environmental Protection Agency

Stormwater Best Management Practices Test Facility

Swales

National Risk Management Research Laboratory

Urban Watershed Research Facility

Edison, NJ

National Risk Management Research Laboratory

Swales

Introduction: Swales are "engineered ditches" that provide stable routing for stormwater runoff. Swales provide a green, low-cost drainage option for highways, farms, industrial, and commercial areas. Beyond enhancing local aesthetics, swales mitigate the pollutants carried by the runoff. They can also reduce both the runoff volume and peak stormwater runoff rate that can damage streams.

Based on the perceived benefits, some communities are requiring developers to incorporate swales into new residential developments as a less expensive and more environmentally - friendly tool to manage stormwater than the curb and gutter alternative. The choice to install swales is part of a general strategy called "Low Impact Development" that incorporates Best Management Practices as part of the initial planning.

EPA recognizes the capabilities of swales to reduce a community's environmental footprint while providing the practical requirements to manage stormwater runoff. This long-term research is addressing the question of how to design, install, and maintain swales to achieve the largest pollutant reduction in the specific application at lower total cost while assuring that the system meets the community's drainage needs.

Research: Controlled-condition research enables the National Risk Management Research Laboratory (NRMRL) to better manage the research project and collect high-quality information. Operating in the

Swales under construction (July 2006)

field limits research because o
of the weather, access, utilities, vandalism, and other logistical issues that collectively add greatly to the cost. On-site swales enable NRMRL to collect the high-quality data needed for engineering design and "push the envelope." When necessary, researchers can alter the dimensions, shape, and runoff volume to engineering failure with no risk to the well being of surrounding population, personal property, or the environment. The controlled-condition experiments are fundamentally safer than attempting research measurements along a busy roadway during a rainstorm and avoids unnecessary risks to people and equipment.

Swale description: Each of the three swales is 40-m (131-ft) long. The steepest swale has a 5% slope, exceeding the upper limit established by many State governments. The flattest swale has a slope of only 0.5%, less than the lowest slope sometimes recommended. The middle swale has a 1% slope, representative of the range often cited as "preferred."

The swales are excavated to have a trapezoidal cross section that routes the water. NRMRL selected this initial shape because it is perceived by many regulators as reducing the maintenance effort and simplifying construction. After collecting data with this shape, NRMRL can alter the cross section, if needed.

The subsurface of each swale is divided into four separate watertight segments. The longitudinal compartmentalization enables researchers to develop computer models that predict infiltration rates and chemical reactions that may occur in the subsurface.

The subsurface is built in four vertical layers. The bottom layer is an impermeable liner that isolates the segment and prevents uncontrolled loss of water that infiltrates through the surface.

A 20-cm (8-in) thick layer of well-washed gravel sits on the impermeable membrane and surrounds a slotted pipe. The pipe routes all infiltrating water to a common exit point where it can be measured and sampled. A porous fabric separates a 30-cm (1-ft) deep replaceable media layer from the gravel.

The uppermost layer is vegetation. The vegetation is thought to provide much of the pollutant reduction in the flowing surface water. The vegetation creates a rough surface that slows the flow and allows particles to settle.

Pipes in the gravel layer allow researchers to collect samples of the infiltrating water for chemical analysis that is performed at the on-site laboratory. Instruments record all flows to and from the swales. The swales have electronic monitoring and logging for surface water depth. Buried sensors measure soil moisture and temperature of the media. The water within the gravel layer is monitored electronically for dissolved oxygen, temperature, pH, turbidity, conductivity, and oxidation-reduction potential.